

**ANS/ISO 1522  
1998(E)**

**Paints and Varnishes—  
Pendulum Damping Test**

Approved as an American National Standard by:

**ASTM International**

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**Paints and varnishes — Pendulum damping  
test**

*Peintures et vernis — Essai d'amortissement du pendule*



Reference number  
ISO 1522:1998(E)

## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 1522, was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This second edition cancels and replaces the first edition (ISO 1522:1973) in which, for both the König and the Persoz pendulum, the time for damping on a polished glass panel has been provided with upper and lower limits. In addition, the standard has been editorially revised.

Annexes A, B and C form an integral part of this International Standard.

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## Introduction

Two test procedures have been considered in some detail, namely those of König and Persoz, which are specified respectively by DIN 53157:1987 and NF T 30-016:1991. The instruments embody the same principle — that the amplitude of oscillation of a pendulum touching a surface decreases more rapidly the softer the surface — but differ in respect of dimensions, period and amplitude of oscillation.

The interaction between the pendulum and the paint film is complex, depending as it does on both elastic and viscoelastic properties, and it is not possible to establish a general relationship between results obtained by the two tests. One type of pendulum only must therefore be used in a given series of measurements of damping time.

The following considerations may serve as a guide in considering which pendulum may offer an advantage for a particular purpose:

- a) On surfaces with a low coefficient of friction, the Persoz pendulum may skid, which would invalidate the results; however, this occurs only rarely in the field of paints and varnishes.
- b) It should be noted that both instruments reflect the sensitivity of the physical properties of a paint to its environment, and the test should therefore be conducted under controlled conditions of temperature and humidity and in the absence of draughts. The thickness of the paint film and the nature of the substrate may also affect the damping times.



# Paints and varnishes — Pendulum damping test

## 1 Scope

This International Standard is one of a series of standards dealing with the sampling and testing of paints, varnishes and related products.

It specifies standard conditions for carrying out a pendulum damping test on a single coating or a multicoat system of paint, varnish or related product.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1512:1991, *Paints and varnishes — Sampling of products in liquid or paste form*.

ISO 1513:1992, *Paints and varnishes — Examination and preparation of samples for testing*.

ISO 1514:1993, *Paints and varnishes — Standard panels for testing*.

ISO 2808:1997, *Paints and varnishes — Determination of film thickness*.

ISO 3270:1984, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*.

ASTM D 4366:1995, *Standard Test Methods for Hardness of Organic Coatings by Pendulum Damping Tests*.

## 3 Required supplementary information

For any particular application, the test method specified in this International Standard needs to be completed by supplementary information. The items of supplementary information are given in annex A.

## 4 Principle

A pendulum resting on a coating surface is set into oscillation and the time for the oscillation amplitude to decrease by a specified amount measured. The shorter the damping time, the lower the hardness.

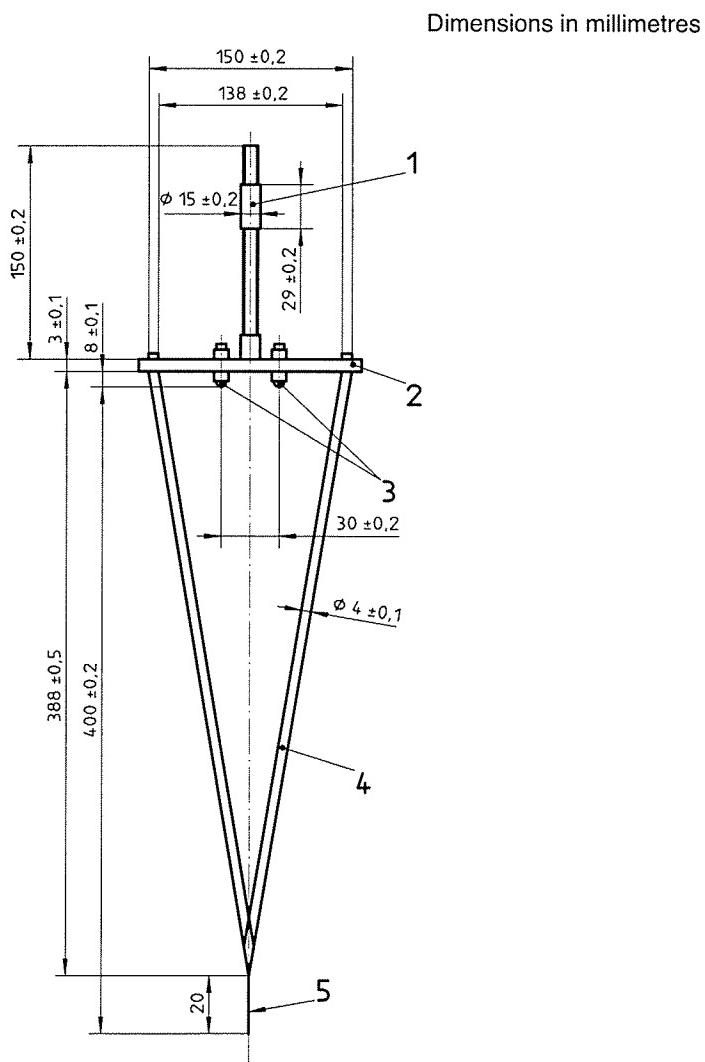
## 5 Apparatus

### 5.1 Pendulum

Both the pendulums described below comprise an open framework connected by a cross-bar on the under face of which two balls are inset to serve as the fulcrum, the lower end of the framework being formed into a pointer. The two pendulums differ in shape, mass, swinging time and other details, as shown in the description in 5.1.1 and 5.1.2.

The pendulum shall be used away from draughts and vibrations, and the use of a protective enclosure is recommended.

**5.1.1 The König pendulum** (see figure 1) rests on two ball bearings of  $(5 \pm 0,005)$  mm diameter,  $(30 \pm 0,2)$  mm apart and of hardness HRC1)  $(63 \pm 3)$  or  $(1\,600 \pm 32)$  HV 30<sup>2</sup>, and is counterpoised (to adjust the natural frequency of oscillation) by means of a weight sliding on a vertical rod attached to the cross-bar. On a polished plate-glass panel the period of oscillation shall be  $(1,40 \pm 0,02)$  s and the time for damping from a  $6^\circ$  displacement to a  $3^\circ$  displacement shall be  $(250 \pm 10)$  s. The total mass of the pendulum shall be  $(200 \pm 0,2)$  g.



- 1 Counterpoise (adjustable)
- 2 Cross-bar, length  $12 \pm 0,1$
- 3 Ball,  $\phi 5$
- 4 Frame
- 5 Tip

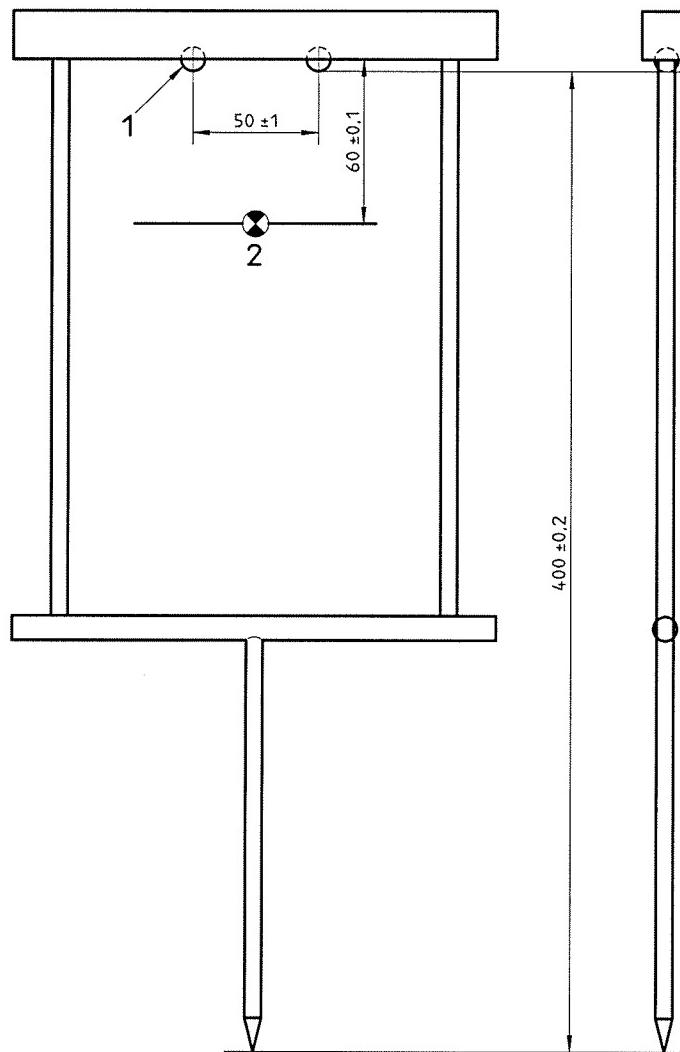
Figure 1 — König pendulum

1) HRC = Rockwell hardness

2) HV = Vickers hardness determined in accordance with DIN 50133

**5.1.2 The Persoz pendulum** (see figure 2) rests on two stainless-steel balls of  $(8 \pm 0,005)$  mm diameter, of hardness HRC  $(59 \pm 1)$  and  $(50 \pm 1)$  mm apart. A counterpoise is not provided. On a polished plate-glass panel, the period of oscillation shall be  $(1 \pm 0,001)$  s and the time for damping from a  $12^\circ$  displacement to a  $4^\circ$  displacement on the same substrate shall be  $(430 \pm 10)$  s. The total mass of the pendulum shall be  $(500 \pm 0,1)$  g and its centre of gravity at rest shall be  $(60 \pm 0,1)$  mm below the plane of the fulcrum, the pointer tip being  $(400 \pm 0,2)$  mm below the plane of the fulcrum.

Dimensions in millimetres



- 1 Ball,  $\varnothing 0,8$
- 2 Centre of gravity

Figure 2 — Persoz pendulum

## 5.2 Instrument stand, for supporting test panel and pendulum.

The stand is common to both pendulums and comprises a heavy supported vertical rod to which is attached a horizontal table with a flat working surface, the dimensions of which may conveniently be 95 mm  $\times$  110 mm and not less than 10 mm thick. The stand also carries a stirrup to support the pendulum away from the table and a mechanism for shock-free lowering of the pendulum on to the test panel.

**5.3 Scale**, on the front of the stand. It is marked to permit reading of the angular displacement of the pendulum either through 6° and 3° (König pendulum) or 12° and 4° (Persoz pendulum) from a centrepoint indicating the rest position of the pendulum. The scale may be moved horizontally, and locked in position, to bring the zero marking and the test position of the pendulum tip into coincidence.

This scale may be marked on a mirror, or a mirror may be placed behind the scale, to assist in eliminating parallax errors during observation.

**5.4 Stopwatch**, or other timing device, for timing the oscillation damping of the pendulum.

**5.5 Polished plate (float) glass panel**, for calibrating the pendulum.

## 6 Sampling

Take a representative sample of the product to be tested (or of each product in the case of a multicoat system), as described in ISO 1512.

Examine and prepare each sample for testing, as described in ISO 1513.

## 7 Test panels

### 7.1 Substrate

Select the substrate from one of those described in ISO 1514, ensuring that the panels are plane, rigid and free from distortion. Metal or glass panels are recommended, with dimensions of approximately 100 mm × 100 mm × 5 mm.

### 7.2 Preparation and coating

Unless otherwise agreed, prepare each test panel in accordance with ISO 1514 and then coat it by the specified method with the product or system under test. The test coating shall then be smooth and free from surface irregularities.

### 7.3 Drying and conditioning

Dry (or stove) and age (if applicable) each coated test panel for the specified time and under the specified conditions. Before testing, condition the test panels at a temperature of  $(23 \pm 2)^\circ\text{C}$  and relative humidity of  $(50 \pm 5)\%$ , unless otherwise agreed, for a minimum of 16 h.

Fingerprints, dust or other contamination on the surface will result in lower accuracy. The coated panels shall therefore be stored and handled in an appropriate way.

### 7.4 Thickness of coating

Determine the thickness, in micrometres, of the dried coating by one of the procedures specified in ISO 2808.

## 8 Procedure

### 8.1 Calibration of the instruments

Procedures for each instrument are given in annexes B and C.

## 8.2 Ambient conditions

Carry out the test at  $(23 \pm 2)^\circ\text{C}$  and a relative humidity of  $(50 \pm 5)\%$ , unless otherwise agreed (see also ISO 3270).

## 8.3 Determination of pendulum damping time

**8.3.1** Place the panel on the table with the paint film uppermost.

**8.3.2** Gently bring the pendulum onto the panel surface.

**8.3.3** Deflect the pendulum, without lateral displacement of the fulcrum, through the appropriate angle ( $6^\circ$  for the König pendulum,  $12^\circ$  for the Persoz pendulum) and allow to rest against the stop provided.

**8.3.4** Release the pendulum and simultaneously start the stopwatch or other timing device.

NOTE — In the case of automatic versions, the damping time will be measured automatically.

**8.3.5** Record the time, in seconds, for the amplitude of swing to decrease from either  $6^\circ$  to  $3^\circ$  (König pendulum) or from  $12^\circ$  to  $4^\circ$  (Persoz pendulum).

**8.3.6** Carry out a determination on three different parts of the same test panel. Record each result and the mean of the three determinations.

## 9 Precision

These data have been taken from ASTM D 4366:1995.

### 9.1 König pendulum

The following criteria should be used for judging the acceptability of results at the 95 % confidence level.

#### 9.1.1 Repeatability, $r$

Two results, each the mean of three determinations on a specimen, obtained by the same operator should be considered suspect if they differ by more than 8 % of their mean value.

#### 9.1.2 Reproducibility, $R$

Two results, each the mean of three determinations on a specimen, obtained by operators in different laboratories should be considered suspect if they differ by more than 23 % of their mean value.

#### 9.1.3 Bias

No statement can be made on bias as the value of König hardness is defined only in terms of this test method.

### 9.2 Persoz pendulum

The following criteria should be used for judging the acceptability of results at the 95 % confidence level.

#### 9.2.1 Repeatability, $r$

Two results, each the mean of three determinations on a specimen, obtained by the same operator should be considered suspect if they differ by more than 3 % of their mean value.

### 9.2.2 Reproducibility, $R$

Two results, each the mean of three determinations on a specimen, obtained by operators in different laboratories should be considered suspect if they differ by more than 8 % of their mean value.

### 9.2.3 Bias

No statement can be made on bias as the value of Persoz hardness is defined only in terms of this test method.

## 10 Test report

The test report shall contain at least the following information:

- a) all details necessary to identify the product tested;
- b) a reference to this International Standard (ISO 1522);
- c) the items of supplementary information referred to in annex A;
- d) a reference to the international or national standard, product specification or other document supplying the information referred to in c);
- e) any deviation from the test method specified;
- f) the result of the test, as indicated in 8.3.6;
- g) the pendulum used (König or Persoz);
- h) the date of the test.

**Annex A**  
(normative)**Required supplementary information**

The items of supplementary information listed in this annex shall be supplied as appropriate to enable the method to be carried out.

The information required should preferably be agreed between the interested parties and may be derived, in part or totally, from an international or national standard or other document related to the product under test.

- a) Substrate material, substrate thickness and surface preparation of the substrate.
- b) Method of application of the test coating to the substrate, including duration and conditions of drying between coats in the case of a multi-coat system.
- c) Duration and conditions of drying (or stoving) and ageing (if applicable) of the coating before testing.
- d) Thickness, in micrometres, of the dry coating and method of measurement in accordance with ISO 2808, and whether it is a single coating or a multi-coat system.
- e) Temperature and relative humidity of the test, if different from those specified in 8.2 (see ISO 3270).

## Annex B (normative)

### **Calibration of the König pendulum**

**B.1** Check the alignment of the pendulum and panel table as follows:

**B.1.1** Place the polished glass panel on the panel table and gently bring the pendulum to rest on the surface of the glass. Be sure the pendulum oscillates freely.

**B.1.2** Place a spirit level on the glass panel surface. Level the glass panel by means of the adjusting screws at the base of the instrument.

**B.1.3** Clean the glass panel by wiping with a soft, lint-free cloth wetted with a suitable solvent

**B.1.4** Clean the fulcrum balls by wiping with a soft tissue wetted with a suitable solvent. Leave the pendulum in ambient conditions and then bring it to rest on the glass panel.

**B.1.5** Check the position of the scale relative to the pendulum pointer. With the pendulum at rest, its pointer should indicate zero on the scale. If the pointer does not indicate zero, move the scale to obtain the correct zero setting.

**B.2** Check the duration of the pendulum swing on the glass panel as follows:

**B.2.1** Deflect the pendulum through  $6^\circ$ , release it and simultaneously start the stopwatch or other timing device.

**B.2.2** Determine whether the time for 100 swings of the pendulum is  $(140 \pm 2)$  s.

**B.2.3** If the measured time is less than specified, move the weight downward. Continue adjustments until the specified time is obtained. If adjustments do not give the required time, the instrument shall be judged faulty and be repaired.

**B.3** Check the duration of damping of the pendulum on the glass panel as follows:

**B.3.1** Deflect the pendulum through  $6^\circ$ , release it and simultaneously start the stopwatch or other timing device.

**B.3.2** Determine whether the time for the amplitude of swing to decrease from  $6^\circ$  to  $3^\circ$  is  $(250 \pm 10)$  s (corresponding to 172 to 185 pendulum swings).

## Annex C (normative)

### **Calibration of the Persoz pendulum**

**C.1** Check the alignment of the pendulum and panel table as follows:

**C.1.1** Place the polished glass panel on the panel table and gently bring the pendulum to rest on the surface of the glass. Be sure the pendulum oscillates freely.

**C.1.2** Place a spirit level on the glass panel surface. Level the glass panel by means of the adjusting screws at the base of the instrument.

**C.1.3** Clean the glass panel by wiping with a soft, lint-free cloth wetted with a suitable solvent

**C.1.4** Clean the fulcrum balls by wiping with a soft tissue wetted with a suitable solvent. Leave the pendulum in ambient conditions and then bring it to rest on the glass panel.

**C.2** Check the duration of the pendulum swing on the glass panel as follows:

**C.2.1** Deflect the pendulum through  $12^\circ$ , release it and simultaneously start the stopwatch or other timing device.

**C.2.2** Determine whether the time for 100 swings of the pendulum is  $(100 \pm 0,1)$  s.

**C.2.3** If this value cannot be achieved, reclean the glass panel and the bearing balls of the pendulum, recheck that the glass panel is level, and retest. It is not permissible to adjust the instrument scale at this point.

**C.3** Check the duration of damping of the pendulum on the glass panel as follows:

**C.3.1** Deflect the pendulum through  $12^\circ$ , release it and simultaneously start the stopwatch or other timing device.

**C.3.2** Determine whether the time for the amplitude of swing to decrease from  $12^\circ$  to  $4^\circ$  is  $(430 \pm 10)$  s.

**C.3.3** If this value cannot be achieved, repeat the glass panel and instrument checks described in C.2.3.

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**Descriptors:** paints, varnishes, tests, damping tests.

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